

Assignment
B.Sc. Chem(Hons) Ist year
Semester II (2020)
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Thermochemistry

- The formation of SO₃ from SO₂ and oxygen,
$$\text{SO}_2(\text{g}) + \frac{1}{2} \text{O}_2(\text{g}) \rightarrow \text{SO}_3(\text{g})$$
is exothermic by 97030 J at 298 K and 1 atm measured in a bomb calorimeter. What is the value of ΔH ?
- Compute the standard heat of formation of methane using the following data:
 - $\text{CH}_4(\text{g}) + 2 \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2 \text{H}_2\text{O}(\text{l}),$
 $\Delta H^\circ(298\text{K}) = -890.35 \text{ KJ}$
 - $\text{H}_2(\text{g}) + \frac{1}{2} \text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l}), \Delta H^\circ(298\text{K}) = -285.84 \text{ KJ}$
 - $\text{C}(\text{graphite}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}), \Delta H^\circ(298\text{K}) = -393.51 \text{ KJ}$
- For a reaction $\text{CO}(\text{g}) + \text{H}_2\text{O}(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2(\text{g}), \Delta H^\circ(298\text{K}) = -42.0 \text{ KJ}.$
The heat capacities of various species are given by
 $C_{P,m}(\text{CO})/\text{JK}^{-1}\text{mol}^{-1} = 26.8 + 7.0 \times 10^{-3} \text{ T}$
 $C_{P,m}(\text{H}_2\text{O}, \text{g})/\text{JK}^{-1}\text{mol}^{-1} = 30.4 + 9.6 \times 10^{-3} \text{ T}$
 $C_{P,m}(\text{CO}_2)/\text{JK}^{-1}\text{mol}^{-1} = 26.0 + 43.5 \times 10^{-3} \text{ T}$
 $C_{P,m}(\text{H}_2)/\text{JK}^{-1}\text{mol}^{-1} = 29.0 + 0.80 \times 10^{-3} \text{ T}$
Calculate (a) $\Delta H^\circ(1298\text{K}),$ (b) $\Delta U^\circ(1298\text{K})$
- Using the bond energy data, compute ΔH° of formation for ethyl alcohol (C₂H₅OH). $DH^\circ(\text{C} - \text{H}) = 413 \text{ kJ}, DH^\circ(\text{C} - \text{C}) = 348 \text{ kJ},$
 $DH^\circ(\text{C} - \text{O}) = 351 \text{ kJ}, DH^\circ(\text{O} - \text{H}) = 463 \text{ kJ}.$

5. It is estimated that an average human brain consumes the equivalents of 10g glucose per hr. Estimate the power output of the brain in watts.

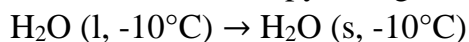
Given that $1\text{W} = 1\text{J}\text{s}^{-1}$;

$$\Delta H^{\circ}f(\text{H}_2\text{O}, \text{l}) = -286 \text{ kJ/mol}$$

$$\Delta H^{\circ}f(\text{CO}_2, \text{g}) = -394 \text{ kJ/mol}$$

$$\Delta H^{\circ}f(\text{glucose}, \text{aq}) = -1260 \text{ kJ/mol}.$$

6. Calculate the enthalpy change for the process



given that:

$$C_{\text{P,m}}(\text{H}_2\text{O}, \text{l}) = 75.4 \text{ JK}^{-1}\text{mol}^{-1}$$

$$C_{\text{P,m}}(\text{H}_2\text{O}, \text{s}) = 37.2 \text{ JK}^{-1}\text{mol}^{-1}$$

$$\text{H}_2\text{O} (\text{l}, 0^{\circ}\text{C}) \rightarrow \text{H}_2\text{O} (\text{s}, 0^{\circ}\text{C}), \Delta H = -6008 \text{ J/mol}.$$

7. The heat of dissociation per mole of gaseous water at 18°C and 1 atm is 241750 J ; calculate its value at 68°C . Data given are $C_{\text{P}}(\text{H}_2\text{O}) = 33.56$; $C_{\text{P}}(\text{H}_2) = 28.83$; $C_{\text{P}}(\text{O}_2) = 29.12 \text{ JK}^{-1}\text{mol}^{-1}$